The Australian general public's perceptions of having a personally controlled electronic health record (PCEHR)

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ABSTRACT

Objective: The move internationally by Governments and other health providers to encourage patients to have their own electronic personal health record (e-PHRs) is growing exponentially. In Australia the initiative for a personally controlled electronic health record (known as PCEHR) is directed towards the public at large. The first objective of this study then, is to examine how individuals in the general population perceive the promoted idea of having a PCEHR. The second objective is to extend research on applying a theoretically derived consumer technology acceptance model to guide the research.
Method: An online survey was conducted to capture the perceptions and beliefs about having a PCEHR identified from technology acceptance models and extant literature. The survey was completed by 750 Queensland respondents, 97% of whom did not have a PCEHR at that time. The model was examined using exploratory factor analysis, regressions and mediation tests.
Results: Findings support eight of the 11 hypothesised relationships in the model. Perceived value and perceived risk were the two most important variables explaining attitude, with perceived usefulness and compatibility being weak but significant. The perception of risk was reduced through partial mediation from trust and privacy concerns. Additionally, web-self efficacy and ease of use partially mediate the relationship between attitude and intentions.
Conclusions: The findings represent a snapshot of the early stages of implementing this Australian initiative and captures the perceptions of Queenslanders who at present do not have a PCEHR. Findings show that while individuals appreciate the value of having this record, they do not appear to regard it as particularly useful at present, nor is it particularly compatible with their current engagement with e-services. Moreover, they will need to have any concerns about the risks alleviated, particularly through an increased sense of trust and reduction of privacy concerns. It is noted that although the respondents are non-adopters, they do not feel that they lack the necessary web skills to set up and use a PCEHR. To the best of our knowledge this is one of a very limited number of studies that examines a national level implementation of an e-PHR system, where take-up of the PCEHR is optional rather than a centralised, mandated requirement.

1. INTRODUCTION

The international interest in introducing e-PHRs has emerged as an important area of research in the medical and health informatics domain [1, 2]. This interest has been summarised in scoping studies, such as [3-5]. Much of the research, however, focuses on 'tethered' e-PHRs [4] meaning records that are offered by a health provider or a specific organisation, such as an employer. 'Untethered' e-PHRs refers to health records that can be installed on a personal computer or Website for personal use and are considered to be standalone records [4].

1.1 Scoping studies on e-PHRs

Of benefit to researchers are scoping studies that provide a background to the extant research on e-PHRs [3-5]. For example, Saparova [3] discusses the characteristics of e-PHRs, giving examples of how they function as persuasive tools, as well as providing findings regarding their efficiency in this role. Archer et al. [4] review articles on e-PHRs' functionality, implementation, application and outcomes, as well as perceived and real benefits of having such health records. The value of this study is the way they categorise the articles using different variables of interest to both system designers and consumer behaviour researchers. Kim et al. [5] focus on the history and trends of PHR research in PubMed journals, identifying journals that publish studies in this area, the countries where the studies took place, the topic categories covered, as well as concepts most often used in the studies.

Collectively these scoping studies suggest three limitations. 1) The focus of the e-PHR studies is related to tethered health records offered by a health provider or employer. Research on untethered e-PHRs is scarce. 2) Most e-PHR research has been done in the United States [4, 5]. 3) At a consumer behaviour level, it is not always possible to compare findings through meta-analyses owing to a lack of common attributes used in the studies [4]. The scoping reviews highlight the need for ongoing research into what motivates individuals to engage with e-PHRs and to use common attributes that can provide generalisable information to predict consumer take-up [3, 4].

1.2 National level implementations of e-PHRs

In addressing limitations 1 and 2 above, literature shows that a number of European and Organisation for Economic Cooperation and Development (OECD) countries are working towards establishing national level implementation of e-PHRs, e.g., [1, 6, 7]. Greenhalgh et al. [1] provide a comparison of a nationally shared e-PHR in four countries in the United Kingdom, with a focus on the managerial issues such as budget, strategy and implementation plans. The comparison case study shows differences in stakeholder alignments, the nature and extent of resistance and record creation rates.

Morrison et al [6] discuss contrasting approaches to nationwide implementations of e-PHRs by reviewing the implementation decisions for three countries, United States , England and Australia, using Coiera's [8] distinction about the approaches to national implementation. 'Top-down (England), is directed by government to replace existing systems to achieve centrally stored and shared e-PHRs. 'Bottom up' (USA) refers to local healthcare agencies holding the e-PHRs with the intention of data sharing as

diverse local systems become integrated over time [6]. This approach reflects the notion of tethered e-PHRs and, as noted from the scoping studies, much of the research into this type of implementation has been conducted in the United States. The 'middle out' system, identified in Australia [6] and New Zealand [7] focuses on standards, rather than government implementation, with nationally agreed interoperability standards and goals delivered through local healthcare providers [6].

1.3 The Australian context for e-PHRs

The middle out approach currently being implemented in Australia is somewhat different from a typical middle out implementation identified earlier, as the emphasis is to empower its citizens through being able to personally control their health information [6]. Therefore, Australian citizens can choose whether or not to have a PCEHR. The Australian PCEHR implementation is regarded as an untethered health record because it is being rolled out at a national level and its take-up is purely voluntary for the end consumer. Such an event provides an interesting opportunity to examine consumers' perceptions, beliefs and behaviours towards having a PCEHR in the early stage of its implementation. Using a technology acceptance theoretical framework, the findings provide insights into what factors predict or explain Australians' likelihood of taking up this potentially empowering initiative.

2.0 CONSUMER ACCEPTANCE OF TECHNOLOGY AND e-PHRs

Through a technology acceptance lens, we examine the third limitation identified in the scoping studies. The need to identify common attributes that can predict consumer take-up is evident in both qualitative and quantitative research on consumer acceptance of e-

PHRs. For example, in general, studies suggests that *perceived usefulness* is important, together with attributes such as *perceived ease of use, convenience/time saving, privacy/confidentiality* that help to explain the outcomes of interest [9-13]. As a point of departure and based on a critique of the often used Technology Acceptance Model [14], Emani et al. [15] applied attributes from Moore and Benbasat's [16] perceived characteristics of innovating (PCI) scale that has yet to be systematically applied in healthcare research. Emani et al.'s findings show that, in addition to ease of use, privacy and security, *relative advantage, trialability* and *observability* were positive predictors for patient acceptance of e-PHRs. We further note, however, that there is limited focus on empirical testing of barriers to adoption. For example, Archer et al. [4] identified only six studies that focus on barriers, while the studies reviewed above only identify *privacy/ security* as barriers to adoption [9-13, 15]. In summarising these findings, it is evident that there are common attributes that impact consumer acceptance of e-PHRs both positively and negatively, although all of them relate to tethered health records.

2.1 What is new in our research?

In summarising the discussion above we seek to address the limitations in the literature identified earlier, as follows. The focus of our study is a significant departure from available research in the area of e-PHRs in two ways. First, the context is people's voluntary take-up of an e-PHR as a member of the general public, rather than as a patient in the health provider environment. Further, we situate the Australian PCEHR as an e-service since it is provided to the general public in a similar way to other e-services that require downloading and inputting of information, such as e-Tax. We therefore describe a PCEHR as an eHealth service, where individuals engage with an online

service platform to download, set up and interact with their record. The individual can input information and data which can then be acted upon in some way to provide benefits to all stakeholders involved. Such a service requires the co-production of activity between the individual and the official authority providing the e-service [17]. Second, the study incorporates a comprehensive set of psychographic constructs facilitating or inhibiting the general public's take-up, an approach that has not yet been undertaken in the context of a voluntary national implementation. Since the value and efficacy of this eHealth service is dependent upon Australian people's acceptance and ultimately continued use of this service, having a stronger understanding of what factors motivate or inhibit their take-up of e-services is an important research issue [18].

2.2 The current situation in Australia

The Australian initiative for PCEHRs formally commenced on 1st July, 2012 with a target of 500,000 individual registrations set for the first 12 months of implementation. The take-up rate by April 2013 was around 75,000 registrations [19] and, around the time of reporting the findings, had risen to around 250,000 by July 2013 [20]. With the low take-up after the first six months, we considered it timely to investigate consumer acceptance of PCEHRs to gain insights into how consumers perceive this eHealth service initiative in the first year of implementation.

3. RESEARCH MODEL AND HYPOTHESES

One of the ongoing criticisms of research in the eHealth area has been the a-theoretical approaches undertaken [4, 15]. This has resulted in a lack of theoretically-informed work to better understand the organisational issue of health information technologies

(HIT) [21]. The technology acceptance models, studied extensively in the Information Systems literature, provide a sound basis for theoretically derived research into HIT (see Holden and Karsh [22] for a review of models and their applications). To address this criticism we use an extended theory of planned behaviour model (TPB) [23], as suggested by Hsu and Chui [18]. This model includes constructs to measure perceived behavioural control, taking into account perceived controllability and self-efficacy. The constructs are measured with scale items derived from the relevant literature. The next section provides a discussion of the theoretical model and the hypothesised relationship to be tested in our study.

3.1 Central relationships in the Theory of Planned Behaviour Model

There are specific relationships consistently applied in the TPB model that involve *intentions, attitude, perceived beliefs, social norms* and *perceived behavioural control*. These relationships are discussed together with their hypotheses as follows:

Attitude-intentions: The outcome construct in the model is *intention*, shown to be an acceptable behavioural measure in the HIT literature [22]. In our study, intention is phrased as an intent to ".... have my own PCEHR...", as engaging with the Federal Government initiative is very new, and is currently an opt-in decision for the general public. The mediating outcome construct, *attitude* is consistent with attitude theory and the TPB model. The rationale is that antecedent beliefs about performing a behaviour predominantly influences an individual's development of a positive or negative attitude towards that behaviour, rather than having a direct influence on performing the

behaviour [23]. Moreover, this relationship is well established in the HIT literature [22]. This relationship is hypothesised as:

H1. Attitudes will positively influence intentions to have a PCEHR.

Social Norms: The influence of *social norms* is considered to be the other major factor that influences adoption intentions, in addition to attitude [23]. It reflects the degree to which someone believes that important others would want them to perform the behaviour. In HIT and eHealth service contexts, results show that this construct's influence is equivocal [24, 25] and should be considered as a contextual inclusion [22]. Hsu and Chu [18] include social norms separated into personal referents and external sources, such as media. Their findings show that both types of social norms influence an individual to use an e-service. In our model these two types of social influence were included in the social norms construct to determine the possible influence of important referents, such as medical professionals, or the influence of media reports. Therefore, it is hypothesised that:

H2. Social norms will positively influence intentions to have a PCEHR.

Perceived beliefs as facilitators to adoption: Two of the antecedent beliefs in our model have been discussed earlier, specifically *perceived usefulness* and *perceived ease of use*, which are well established in the literature. However, applications of these two constructs in health care research has shown that *perceived ease of use* is less likely to

have a direct effect on attitude or intentions as technology that is difficult to use, would not be perceived as being useful [22]. Therefore, it is hypothesised that:

H3. Perceived usefulness will have a direct, positive influence on attitude.
H4. Perceived ease of use will have an indirect, positive influence on attitude through perceived usefulness.

In terms of other antecedent beliefs about electronic personal health records, Emani et al. [15] found that relative advantage was significant in explaining satisfaction with PHRs. In our model we have included *compatibility*, rather than relative advantage as Australian consumers have limited experience with personally controlling their health records, thus comparing the PCHER's relative advantages against, say, practitioner held records is somewhat redundant. Additionally, since we position the PCEHR as an e-service, trying to determine how compatible it might be with people's engagement with other e-services, such as online banking and eTax is considered more useful. The model also includes *perceived value*, which is sometimes used as the outcome construct in such research, for example [22]. As the PCEHR has only recently been introduced in Australia, being capable of perceiving its value as an outcome seems less productive. Therefore, we positioned perceived value as an antecedent belief to attitude to capture whether people perceive this e-service as being of value to them. Hypotheses for these two constructs are stated as:

H5. Perceived compatibility will have a positive influence on attitude.
H6. Perceived value will have a positive influence on attitude.

Perceived behavioural control: In a TPB model, the perceived behavioural control (PBC) construct mediates the relationship between attitude and intentions in terms of how an individual perceives their capacity to perform the behaviour. Holden and Karsh [22] found that in every study reviewed the relationship between PBC and intentions was statistically significant, suggesting this construct is an important inclusion in our model. In an e-service context this construct relates to an individual's sense of how much control they have regarding participating in the service [18]. With the PCEHR initiative being optional, in that individuals can choose whether to have one or not - we have construed this construct in terms of their sense of control over whether they should have a record or not and perceptions of control over their record if they were to set one up. Therefore it is hypothesised that:

H7. A stronger sense of controllability will positively mediate the relationship between attitude and intention.

3.2. Extending the Theory of Planned Behaviour model

The technology acceptance literature identifies further constructs that should be examined, thereby extending the original TPB model to provide additional explanatory value. These are discussed and their hypotheses stated.

3.2.1 *Perceived risk*:

This construct is included although it is not accounted for in the review of technology acceptance models in HIT [22]. Neither is it accounted for in research on tethered e-

PHRs. In other research contexts, such as online purchasing, perceived risk is construed as a subjective perception about engaging with the Internet environment itself [26, 27], and invariably has a negative influence on attitude or intentions to adopt. In an e-service context, Hsu and Chu [18] include perceived risk, construed as an extrinsic risk in terms of 'costs' if the service fails to perform, rather than intrinsic concerns about engaging with the environment of the e-service. We have therefore included perceived risk as an antecedent belief that can act as a barrier to adoption. This construct is construed as a subjective perception of engaging with personal health information stored in an online environment and it is hypothesised that:

H8. Perceived risk will negatively influence attitude.

3.2.2 Additional mediating constructs

Models of consumer acceptance often have more explanatory value through mediating constructs, in addition to explaining direct effects. In the TPB model, the only mediating construct is that of perceived behavioural control. We extend this model by introducing two additional constructs that are hypothesised to act as mediators in the central relationships of the model.

Trust and *privacy concerns* : Perceived risk in Web-based contexts is often mitigated by a sense of *trust* in the offering agency [27] acting as a mediating construct. Again perceived trust is not specifically evident in the e-PHR literature, but it can be assumed that a patient would trust their health care provider to safeguard their medical information. Studies on e-PHRs identify privacy concerns, such as security and

confidentiality of their information contained in PHRs or health databases, as well as information provided to online agencies [9, 13, 15]. In instances of tethered e-PHRs, where the agency is known and trusted by the patient, high levels of trust should reduce perceptions of risk, thereby having a positive influence. However, where the agency is less well-known or understood, such as an undetermined Federal Government agency in the Australian context, together with the newness of the initiative, it is anticipated that *privacy concerns* may also mediate between perceived risk and attitude towards having a PCEHR. Therefore, the higher the privacy concerns, the less likely they are to reduce perceptions of risk. Thus it is hypothesised that:

H9. Higher perceived trust will positively mediate the relationship between perceived risk and attitude.

H10. Higher privacy concerns will negatively mediate the relationship between perceived risk and attitude.

Web-self efficacy: It is recognised that individuals have become much more familiar with using the Internet for commercial and social activity, as well as the delivery of online services. In eHealth service delivery where individuals are not just passive recipients, the individual needs to feel able to co-produce the service by downloading, setting up and inputting information [17]. In their model, Hsu and Chu discuss and test: 1) a general construct for self-efficacy in using the Internet, and 2) a Web-specific self-efficacy construct capturing 'an individual's perception of efficacy in using a specific WWW application, in this case e-Tax [18]. Their findings show that Web-specific self-efficacy is significant, explaining 11% of the variance in intentions to use the e-service

and 16% of actual usage [18]. The PCEHR is a new e-service that individuals of all ages are encouraged to register for, and set up own their record. Moreover, the benefits of this e-service are more actively accrued to the user through ongoing use to manage their health, rather than simply adoption. Therefore, the inclusion of Web-specific self-efficacy is important to better understand how individuals feel about their capability to use it. Thus, it is hypothesised that:

H11. Perceived web-self efficacy should positively mediate the relationship between attitude and intentions.

The theoretical model and the hypothesised relationships between constructs are shown in Figure 1.

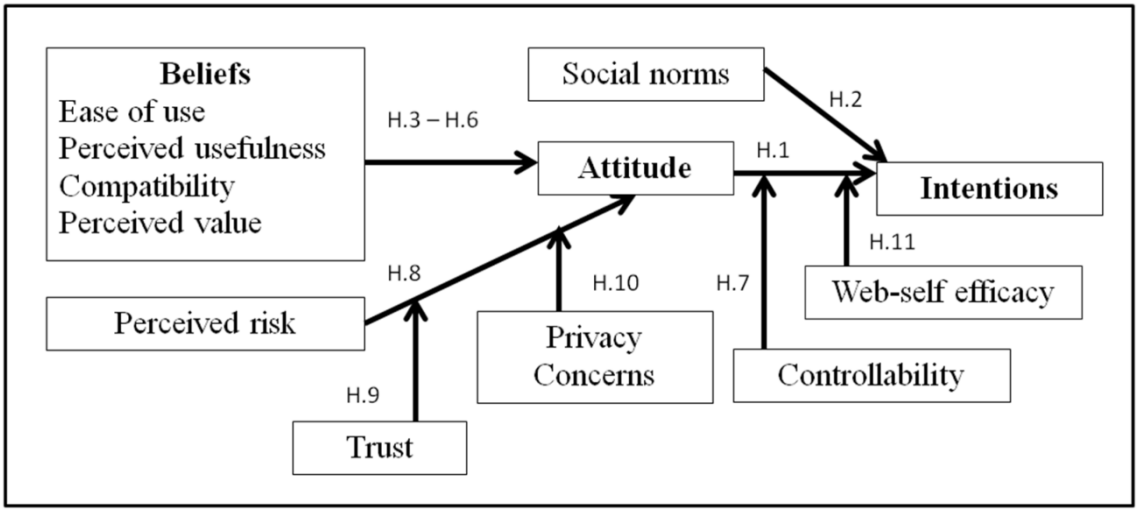

Figure 1: Model for consumer acceptance of a voluntary PCEHR

4. METHODOLOGY

The conceptual model depicted in Figure 1 is tested using a single quantitative study. We used an online survey research design as we felt it was important that respondents

were familiar with using the Internet to be able to provide reliable information about having a PCEHR as it represents an e-service.

4.1 Research design and data collection processes.

The research was conducted in Queensland, the second largest state, covering 1.729,958 km^2 with a population of just over 4.5 million as at September, 2012 [28]. While much of this population is located in South East Queensland, the issues regarding facilitating health service delivery to all Queenslanders, regardless of their location, is a strong focus for the State Government [29].

The online survey was divided into three main sections. Section one examined respondents' frequency of engagement with Web 2.0 eHealth services, identified as health prevention or health intervention services offered through mobile phone technologies using SMS, Apps or mobile Web. This section provides insights into whether respondents are engaging with e-services in healthcare. Section two examined their perceived beliefs about having a PCEHR using a screening question as to whether they currently had one or not. Section three collected demographic data to describe the sample. Small batches of questions were served to participants for completion, using NEXT buttons to move through the sets. Response formats involved dropdown menus or point and click radio buttons to facilitate easy mouse-based completion.

4.1.1 Measures

Where possible, constructs' scale items were drawn from the relevant literature relating to consumer technology acceptance research and adapted to the PCEHR context. The

survey contained a total of 46 items that measure the constructs depicted in the model and to test the relationships hypothesised. Perceived ease of use, Perceived usefulness and Compatibility items were adapted from diverse consumer acceptance of interactive communication technology studies (e.g. [26, 27]), all of which were informed by Moore and Benbasat [16]. Social norms, perceived risk, web-self efficacy, perceived controllability and 2 items for intentions were adapted from Hsu and Chui [18]. Trust was informed and adapted from McCole et al.[30]. Perceived value items were developed for the context of the study. Attitude was informed by Oliver and Bearden [31]. Wording of the scale items was adapted to fit the context of the research and examined by the researchers to determine whether they captured the constructs concerned. All items were measured using 6-Point Likert scales ranging from: (1) *strongly disagree* to (6) - *strongly agree*. We did not provide a middle point of neither agree nor disagree as we wished to gain their opinions about this initiative in its early stages of roll-out. The constructs and their provenance, together with their items are provided as supplementary material.

4.1.2 Participants

We purchased a sample of 750 respondents for the study from a Market Research company in Australia who offer access to their consumer panel. This company complies with the relevant bodies for market research activity through membership with European Society for Opinion and Marketing Research (ESOMAR) and Association of Market and Social Research Organisations (AMSRS). Respondents were recruited to participate in the online survey and were incentivised by the Market Research company through redeemable points, as is customary in this type of recruitment. The criteria for

participation were that they lived in Queensland, were between the ages of 18 years to 65 years in age. We also requested that the sample was composed of an even number of men and women.

4.1.3 Research procedures

Ethical clearance was provided by the University's Ethics Committee prior to recruiting the sample. Data was collected using an online survey hosted on a Metropolitan University's Business School's website. The Market Research company used a script to connect to the research website to facilitate survey completion by their panel members who meet the criteria for the research. The survey was available for three weeks from early December, 2012, and reflects the situation in the early implementation stage of this Federal Government initiative.

4.2 Data analysis

Preliminary examination of the scale items involved exploratory factory analysis to determine the factor loadings for the various scales. The model was tested using a combination of regression analysis and tests for mediation.

5. RESULTS

5.1 Study respondents.

The final sample contained 750 participants and Table 1 shows the basic sample demographics. Respondents are equally divided in terms of gender as a requested criterion for recruiting the sample. Age groups range from 20 - 25 through to 55-65

years with 502 (67%) of the sample located in the two age groups ranging from over 25 to under 55 years.

Table 1: Demographic characteristics of the sample

Demographic Characteristic		No	%
Gender	Males	375	50
	Females	375	50
Age	20 - 25	87	11
	Over 25 but under 40	261	35
	Over 40 but under 55	241	32
	Over 55 but under 65	161	21
Technology use	Access to Internet	750	100
	Uses mobile phone with SMS capability	719	96
	Owns Smartphone	504	67
	Uses Tablet computing	234	31

All respondents have access to the Internet, 719 (96%) use a mobile phone with SMS capabilities, 504 (67%) own Smartphone; and, 234 (31%) use a Tablet computer. In the survey, we explored respondents' frequency of use with Web2.0 eHealth services, identified as health prevention or health intervention services, offered through mobile phone technologies using Mobile Web, SMS or Apps. Although respondents' occasional to frequent usage ranges from 7% to 35% depending on the service, it does show their interest in using eHealth services. These findings are shown in Table 2.

Table 2: Summary of engagement with Web2.0 prevention and intervention eHealth services using mobile phone technologies

eHealth Service through mobile phone technologies	Occasionally-frequently used	%
Mobile Web health prevention service (n=504)	171	34
Mobile Web health intervention service (n=504)	134	27
SMS-based health intervention service (n=719)	52	7

App-based health prevention service (n=504)	174	35
App-based health intervention service (n=504)	131	26

5.2 Health rating and awareness of the PCEHR initiative

When asked how interested they are in managing their personal health at present, 251 participants (33%) indicate limited interest. In contrast, 253 (34%) respondents were interested and 246 (33%) were very interested in managing their personal health, representing 67% of the sample. When rating their present health, 98 (13%) of respondents said it was very poor to poor, 268 (36%) said it was average. Results also show that 286 respondents (38%) indicated good health and 98 respondents (13%) indicated very good health. Therefore, only 50% of the respondents, regardless of their age category, believe they are in good health at present.

In the current study, 506 (67%) indicated that they had *not* heard about the Federal Government initiative and 632 (84%) indicated they had not heard about it through online news/current affairs services that they use. Regarding medical practitioner support for the initiative, 718 (96%) participants indicated they had *not* been approached by their medical practitioner to set one up. In fact, only 26 respondents (approximately 4%) had set up their PCEHR within the first six months of the rollout of the initiative.

5.3 Analysis of the scale items.

The constructs' scale items were subjected to exploratory factor analysis (EFA) with a varimax rotation in SPSS vs21.0 [32]. The reason for doing exploratory factor analysis,

rather than confirmatory factor analysis was to get a clear picture of how the scale items load on their factors, given the somewhat exploratory nature of the study and the integration of measures from e-service research. Additionally, we wanted to take into account that people generally are more computer literate and familiar with engaging with a variety of e-health services using various forms of ICTs in the 2000s. Therefore, some factors may not necessarily load separately, but rather, may suggest higher order factors that better represent constructs in the model.

The initial factor solution indicated five factors with Eigenvalues over one that explained 72% of the variance. An inspection of the loadings suggested the removal of four items, as well as the measures for the Social norms construct. In the second iteration, the resulting scree plot and rotated solution indicated five factors explaining 73% of the variance. There is evidence of higher order factors represented by several constructs. The Cronbach alphas were calculated for both the higher order factors and the individual factors to determine their internal reliabilities. Table 3 shows the factors and their loadings.

In terms of perceived beliefs, items for *compatibility (*$\alpha = .93$), *perceived value* ($\alpha = .90$) and *perceived usefulness* ($\alpha = .83$) all loaded under one factor in the EFA which reflect a higher order factor that we have named Value Propositions ($\alpha = .97$). All items for *perceived risk* ($\alpha = .92$) loaded on one factor. The Cronbach alphas for each of the variables are above the acceptable levels, suggesting they reflect good internal reliability to measure their identified factors.

Regarding those constructs hypothesised to mediate relationships, the analysis shows two higher order factors. The first one contains *perceived ease of use* (α = .83) and *web-self efficacy* (α = .91) and has been named Internet Capability (α = .84). Prior studies have found that perceived ease of use often has an indirect effect on attitude through perceived usefulness [24, 27]. However, in our case, its loading with Web-self efficacy is intuitively understandable as there should be a relationship between the two since an individual's perceptions of their self-efficacy would then influence their perceptions of how easy the system would be to use [22].

The second higher order factor, named Protection (α = 93), contains *privacy concerns* (α = .81) and *trust* (α = .90) both of which are hypothesised to mediate between perceived risk and attitude. Again this higher order factor makes sense as the items for the two variables reflect the idea of the PCEHR information being protected by the authority in charge. Prior research shows that privacy concerns are important regarding e-services where personal or confidential information is provided online, and trust in the organisation has been shown to be important [33]. Having both variables in a model examining technology acceptance model is not usual, however, that they load together in the factor analysis is intuitively interpretable as they both reflect ways to reduce risk through perceiving that organisation will protect them.

Controllability has two items and thus can only be subjected to a correlation analysis in EFA (r = .226), rather than a Cronbach alpha statistic. This construct is retained in the model to represent the perceived behavioural control variable in an extended TPB model as identified in Hsu and Chui [18]. Items for *intentions* (α = .92), and *attitude* (α

= .92) loaded cleanly on their variables. All items for the factors identified in the EFA were computed into composite constructs to test hypotheses shown in the model.

Table 3: Rotated Component Matrix

Factors	1	2	3	4	5
Value Propositions (α = .97)					
Compat2	.70				
Compat3	.76				
Compat4	.75				
	α = .93				
PerVal1	.66				
PerVal2	.73				
PerVal3	.79				
	α = .90				
PU1	.70				
PU2	.79				
PU3	.87				
PU4	.80				
	α = .83				
Protection (α = .93)					
Privacy1		.76			
Privacy2		.75			
Privacy3		.61			
		α = .81			
Trust					
Trust1		.66			
Trust2		.70			
Trust3		.70			
Trust4		.69			
Trust5		.75			
		α = .90			
Internet Capability (α = .84)					
EoU1			.59		
EoU2			.70		
EoU3			.76		
EoU4			.75		
			α = .83		
WebSelfE1			.56		
WebSelfE2			.70		
WebSelfE3			.73		
WebSelfE4			.79		
			α = .91		
Perceived Risk (α = .92)					
PerRisk3				.71	
PerRisk4				.83	
PerRisk5				.86	
PerRisk6				.87	

Controllability (r = . 226)	
PCextrinsic1	.82
PCintrisic1	.62

5.4 Testing of the hypotheses

Regression analysis is used to test the central relationships in the TPB model indicated by H1 - H7. Results show that 50% of the variance in *intentions* is explained by *attitude* (β = .71, p <.001), supporting H1. H2 cannot be tested as the items for social norms did not load satisfactorily on this construct.

Regarding consumers' beliefs that are hypothesised to positively influence attitude, results show that 72% of the variance in attitude is explained by four beliefs. In order of importance, they are *perceived value* (β = .35, p <.01), *perceived usefulness* (β = .15, p <.01) and *compatibility* (β = .14, p <.001) supporting H3, H5 and H6. To test the influence of *perceived risk,* on attitude, this variable was entered into the same regression with other beliefs tested in H3 - H6. Results show that *perceived risk* (β = -.32, P <.01) is significant, supporting H8 that it negatively influences attitude and is the second most important explanatory variable. We note that H4 relating to *perceived ease of use* is not testable as in the factor analysis this variable loaded with *web self-efficacy* which is hypothesised to act as a mediating variable.

5.4.1 Tests for mediation

We applied the Baron and Kenny method [34] depicted in Figure 2. Three equations are used to test for mediation. Equation 1 (Eq1) tests whether the independent variable has

an effect on the mediator (Path *a*). Eq2 tests whether the independent variable has an effect on the outcome variable. Then the actual test of mediation occurs in Eq3 that tests whether the mediator and the independent variable have an effect on the outcome variable. Total mediations is said to have occurred when the result in the previously significant relationship between the independent variable and the outcome variable is no longer significant. When its effect is statistically significant and reduced compared to EQ2, then partial mediation has occurred. According to Baron and Kenny (1986, p. 1177) "*To establish mediation, the following conditions must hold: First, the independent variable must affect the mediator in the first equation; second, the independent variable must be shown to affect the dependent variable in the second equation; and third, the mediator must affect the dependent variable in the third equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second.*"

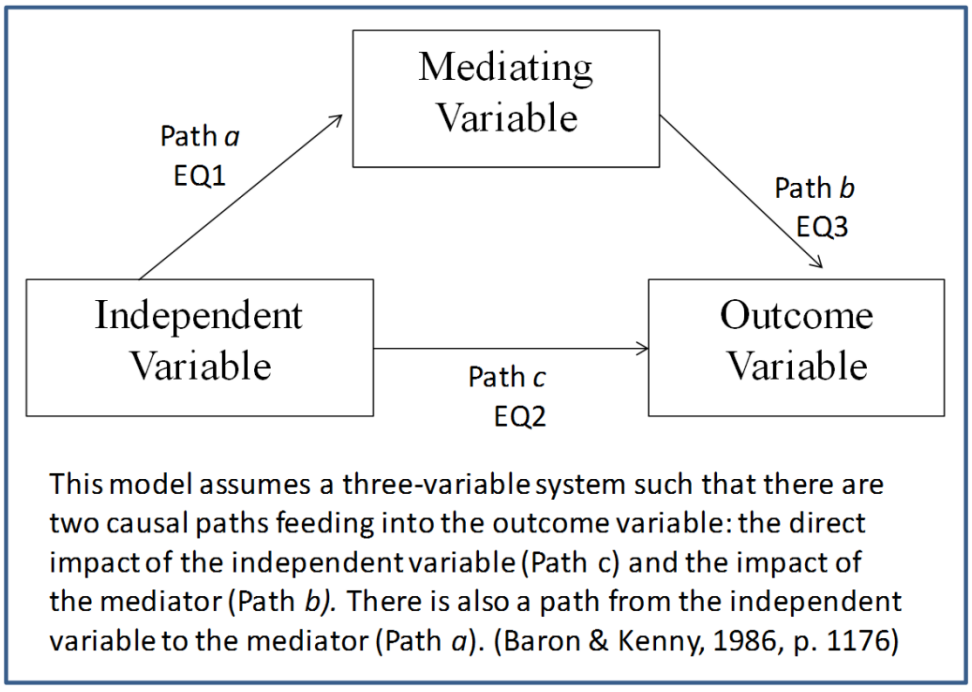

Figure 2: Model of mediation adapted from Baron and Kenny (1986)

The first test of mediation is that of *Controllability* representing the perceived behavioural control component of a TPB model that mediates between attitudes and intentions to perform a behaviour. Results show that H7 is not supported as there is no statistically significant effect between attitude and controllability in EQ1 so the rest of the tests are not required.

The second tests for mediation examine H9 and H10 relating to the mediating effects of *trust* and *privacy concerns* on the relationship between *perceived risk* and *attitude*. The full mediation test results are shown in Tables 4 (a) and (b). A check of the means for the items measuring *Trust* show a range from 3.33 to 3.89, suggesting a moderate level of trust in the Government agency. For *privacy concerns* the means range of 3.64 to 3.72, suggesting a moderate level of concern about the privacy and confidentiality issues to do with having a PCEHR.

Results show that *trust* partially mediates the relationship between perceived risk and attitude as the effect for *perceived risk* is reduced from β = -.67 in Eq2 to β = -.45 in Eq3. *Privacy concerns* also partially mediate the relationship between perceived risk and attitude as the effect *perceived risk* is reduced from β = -.67 in Eq2 to β = -.46 in Eq3. Therefore, both trust and privacy concerns act as partial mediators so H9 and H10 are supported.

Table 4(a): Mediation test for trust on the relationship between perceived risk and attitude

Eq1: Perceived risk and trust

Adj. R^2 =.19 Perceived risk (β= -.44, p<.01)
Eq2: Perceived risk and attitude Adj. R^2 =.45 Perceived risk (β= -.67, p<.01)
Eq3: **Perceived risk, trust and attitude** Adj. R^2 =.65 Perceived risk (β= -.45, p<.01) Trust (β=.50, p>.05)
Partial mediation has occurred

Table 4(b): Mediation tests of privacy concerns on the relationship between perceived risk and attitude.

Eq1: Perceived risk and privacy concerns Adj. R^2 =.20 Perceived risk (β= -.45, p<.01)
Eq2: Perceived risk and attitude Adj. R^2 =.45 Perceived risk (β= -.67, p<.01)
Eq3: **Perceived risk, privacy concerns and attitude** Adj. R^2 =.63 Perceived risk (β= -.46, p<.01) Privacy concerns (β=.47, p<.01)
Partial mediation has occurred

The factor analysis showed that *perceived ease of use* and *web-self efficacy* loaded on a higher order factor named Internet capability. We hypothesised that *web-self efficacy* should act as a mediating influence between attitude and intention. Results show that *web-self efficacy* partially mediates the relationship between attitude and intentions as the effect for *attitude* is reduced from β = .71 in Eq2 to β = .54 in Eq3. For *perceived ease of use*, which was not hypothesised to influence this relationship, but loaded with web-self efficacy in the factor analysis, this factor also partially mediate the relationship between attitude and intentions as the effect *attitude* is reduced from β = .71 in Eq2 to β = .63 in Eq3. In testing these two factors that partially mediate the relationship between attitudes and intentions, it is noted that *web-self efficacy* has the stronger statistical power of the two. The full mediation test results are shown in Tables 5 (a) and (b).

Table 5(a): Mediation tests for Web-self efficacy on the relationship between attitude and intention.

Eq1: Attitude and web-self efficacy
Adj. R^2 =.43
Attitude (β=.66, p<.01)
Eq2: Attitude and intentions
Adj. R^2 =.50
Attitude (β=.71, p<.01)
Eq3: Attitude, web-self efficacy and intentions
Adj. R^2 =.53
Attitude (β=.54, p<.01)
Web-self efficacy (β=.25, p<.01)
Partial mediation has occurred

Table 5(b): Mediation tests for perceived ease of use on the relationship between attitude and intention.

Eq1: Attitude and perceived ease of use
Adj. R^2 =.20
Attitude (β=.34, p<.01)
Eq2: Attitude and intentions
Adj. R^2 =.50
Attitude (β=.71, p<.01)
Eq3: Attitude, perceived ease of use and intentions
Adj. R^2 =.51
Attitude (β=.63, p<.01)
Perceived ease of use (β=.14, p<.01)
Partial mediation has occurred

This section has discussed the results for the eleven hypotheses posed. Table 6 summarises the support for these hypotheses.

Table 6: Summary of support for the hypotheses.

Hypothesis	
H1. Attitudes will positively influence intentions to have a PCEHR.	Supported
H2. Social norms will positively influence intentions to have a PCEHR.	Not testable
H3. Perceived usefulness will have a direct, positive influence on attitude.	Supported
H4. Perceived ease of use will have an indirect, positive influence on attitude through perceived usefulness.	Not testable
H5. Perceived compatibility will have a positive influence on attitude.	Supported
H6. Perceived value will have a positive influence on attitude.	Supported
H7. Controllability will positively mediate the relationship between attitude and intention	Not supported
H8. Perceived risk will negatively influence attitude.	Supported
H9. Perceived trust will positively mediate the relationship between perceived risk and attitude.	Supported
H10. Privacy concerns will positively mediate the relationship between perceived risk and attitude.	Supported
H11. Perceived web-self efficacy will positively mediate the relationship between attitude and intentions.	Supported

6. DISCUSSION AND CONCLUSIONS

The objective of the research was to examine what psychographic factors influence consumer acceptance of an e-service, namely the PCEHR. Any innovation needs to be perceived as being an improvement over what is currently available and the Government's introduction of the PCEHR is no different. To be successful, the PCEHR needs to provide recognisable value propositions that fit with Australians' needs. In terms of such propositions, the findings show that individuals' perceived value of having a PCEHR is the most important factor. But in terms of other value propositions that would encourage take up, such as how useful it would be, or how easy it would be to use, they are not strong predictors of future take-up. Bearing in mind that only 50% of the sample rated themselves as being in good health, and 67% of respondents are interested in managing their health, these findings are somewhat surprising. The PCEHR is promoted as providing Australians with an easier and more effective means to manage their own health, thereby empowering them to have control over this important issue, but this is not apparent in our study.

Of additional interest, our findings show that PCEHRs are not perceived as being particularly *compatible* with other e-service activities that respondents may use. Although we did not investigate their use of other e-services as such, we did survey respondents about their engagement with Web2.0 eHealth services through mobile phone technologies. Those findings show a relatively low level of engagement, but this may be an artefact of the facilitating technologies and eHealth services investigated, rather than a general lack of engagement with e-services per se. The finding regarding compatibility is interesting as many organisations and agencies are keen to engage with

their customers through the Web-based channels to gain cost efficiencies and to deliver uniform services. Such a push may mean that people are simply webbed-out and lack the enthusiasm for further self- service work. So in terms of positive influencers, the findings tend to reflect a less than enthusiastic attitude towards having a PCEHR.

As anticipated, perceptions of risk about having a PCEHR have a relatively strong influence on attitude. Moreover, this is the second most important explanatory variable in the model, reflecting respondents concerns about this eHealth initiative that may be creating a barrier towards its adoption. This finding is understandable given the national implementation of the initiative compared to most people's current experiences with computerised health records at their medical practitioner. Our findings suggest, however, that perceived risk can be partially reduced through factors that reflect protection against possible negative outcomes. Respondents expressed moderate perceptions about the national system being trustworthy and secure and that their medical records will remain confidential, similar to other findings, e.g. [33, 35, 36]. Even so, it will be important that the Government or implementing agencies, such as medical practitioners, communicate appropriately to allay any trust and privacy concerns. We note, however, that at the medical practitioner level, encouragement to take up a PCEHR is limited as 95% of respondents indicated that they had not been approached by their doctor to do so, even after six months of implementation.

For non-adopters, a positive attitude is often a sound indicator that individuals will engage in the behaviour at some future point. However, the somewhat less than enthusiastic perceptions reflected in attitude only being a moderate predictor of

respondents' future intentions to have a PCEHR in the next 12 months, suggest ambivalence towards the initiative.

With any innovative ICT initiative, particularly one that is being rolled out on a large scale across a diverse population, it is important to investigate notions of perceived behavioural control. This aspect focuses on whether individuals believe that they have the capacity to control and perform the behaviour under investigation, as framed in the theory of planned behaviour. We situated the PCEHR as an e-service, one that needs to be downloaded from the Internet and set up and then managed in an interactive way through online tools. So investigating the respondents' perceptions of the degree to which they can control their adoption, and their capacity to set up and use the PCEHR is important. Findings show that although perceptions of being able to control whether or not they have the record is not significant, web-self efficacy partially mediates the relationship between attitude and intentions to have a PCEHR in the future. This is further supported by the finding that they perceive that doing so will be easy for them. This shows that the respondents perceive that they would be able to do what is required to set up and use such an e-service, despite not having actually done so, similar to the elderly respondents' opinions in Kerai et al [35]. So it will be important that setting up and using the system is intuitively easy for individuals to do, and where possible, consistent with the types of online functionalities that people are already used to.

The study is not without its limitations. First, respondents were recruited in Queensland only and had an upper age restriction of 65 years. Thus, the findings may not be generalisable Australia-wide, or to people over 65, even though there are some

consistencies with findings from a recent PCEHR study in Australia on people over 60 [35]. Second, while it was not our intention to specifically examine non-adopters, only 3.5% of respondents had set up a PCEHR. As a result, our findings relate to peoples' perceptions of factors that may act as facilitators or barriers to take-up even though they may not have had any experience with setting up or using the PCEHR e-service. Such an approach, however, is in keeping with existing studies in e-health research. Examples include: identifying elderly Australians opinions regarding the acceptance of the concept of PCEHRs, rather than their actual experience [35], or gaining insights into perceptions and motivations for using an SMS-assisted smoking cessation intervention in countries where it was not available at that time [24]. Thus, we argue that understanding perceptions of non-users regarding having a PCEHR, particularly in the early stages of its implementation, can provide important insights for those involved with the continued roll-out of this initiative.

In conclusion, our study contributes to understanding the underlying facilitators and barriers to adopting this national level implementation of a voluntary PCEHR. It also contributes to the ongoing research into consumer behaviour and ePHRs as well as reviews of the research into health records [3-5] and more recently [37]. Bearing in mind that this research is an unintentional study of non-adopters, the overall findings suggest one of ambivalence towards adopting the initiative at present. However, the study is limited to the Queensland population and a national study should be undertaken to gain a larger perspective. Additionally, as the initiative continues to roll out, further research will be important on both adopters to determine what factors encourage ongoing usage, as well as what is inhibiting non-adopters of the PCEHR.

Summary Points

What is already known on this topic

- Patients are prepared to engage with tethered health records when facilitated by their medical practitioners or hospital providers.
- Technology acceptance models have utility in explaining factors that influence outcomes such as satisfaction with using e-PHRs.
- Much of the literature focuses on tethered e-PHRs

What has this study added to our knowledge

- The study identifies factors that provide insights into individuals' lack of take-up of a national level implementation of a non-mandated, untethered e-PHR system during its first year.
- The value propositions of having a PCEHR, such as value, usefulness or compatibility, are not regarded highly by the respondents, suggesting a degree of ambivalence towards the initiative. This ambivalence is not strongly affected by risk, trust or privacy concerns, nor do respondents perceive themselves as lacking in web-skills to set up their record.
- As critical mass for take-up is lagging, the study highlights the need for ongoing research into individuals' adoption behaviour as the initiative moves into its second year of implementation.

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Conflict of interest

The authors declare that they have no conflicts of interest to disclose.

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Author contributions

LA was responsible for the study conceptualisation, All three authors were involved in the development of the survey instrument, LA was responsible for the data collection phase, RG and LA were responsible for the data analysis, RG, TS and LA were responsible for results reporting. All authors were responsible for revisions and editing of the manuscript. All authors confirm that they had complete access to the study data supporting this publication.

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